

ABSTRACT OF THE DISCLOSURE

5 A fluidized bed reactor with one or more stages each stage having a heating section located below a reacting section and a mechanism that pulses granules back and forth between the heating and reacting sections, separate
10 injectors for silicon containing gases non silicon containing gases, heaters to heat the non silicon containing gases above the reaction temperature and the silicon containing gases to a temperature just below their decomposition temperature. The heater for the silicon containing gases controls the condensing vapor of a heat transfer fluid to a temperature below the decomposition
15 temperature of the silicon containing gases. An enclosed noncontaminating sieving device selectively removes product and recycles undersize material. A weigh cell with frequency analysis capability provides information on the weight of the reactor and the force exerted by the pulsing action of the granules.

5 throughputs for a given footprint. It also allows production of very large beads in the bottom section and in the case of silane operation at lower hydrogen to silane ratios, which reduces the risk of contamination. It is possible to have as many stages as is desired and to adjust the diameter of each section independently.

10 Additional novel features are; heat recovery from granules by direct contact with non silicon containing gases; external flow control of each injection point; heating of the silicon containing gases by a liquid or vapor whose temperature is not high enough to cause decomposition of the gases, measuring reactor weight and
15 pulsing force continuously and using one or more high efficiency cyclones to removes small diameter dust.

Additional benefits of the design are that separating the heater and reactor section enables the use of cheap resistance heaters and of different diameters
20 for the two sections, the pulsing action itself polishes the granules, recirculation and reinjection into the reactor of the undersize granules provides new seed particles.

25 While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of
30 the invention as defined by the appended claims.

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10 ~~A Machine for Production of Granular Silicon which provides a~~ fluidized
 bed reactor with one or more stages each stage having a heating section located
 below a reacting section and a mechanism that pulses granules back and forth
 between the heating and reacting sections, separate ~~cooled~~ injectors for silicon
 containing gases and ~~uncooled injectors for non silicon containing gases~~, heaters
 to heat the non silicon containing gases above the reaction temperature and the
 silicon containing gases to a temperature just below their decomposition
 temperature. ~~In the preferred embodiment the~~ The heater for the silicon
 15 containing gases controls the condensing vapor of a heat transfer fluid to a
 temperature below the decomposition temperature of the silicon containing
 gases. ~~The preferred design for cooling the injectors uses a water cooled~~
~~microchannel design, which minimizes parasitic heat losses.~~ An further
~~preferred feature is the use of an enclosed noncontaminating sieving device to~~
 20 selectively removes product and recycles undersize material. An additional
~~feature are the use of a weigh cell with frequency analysis capability to provides~~
 information on the weight of the reactor and the force exerted by the pulsing
 action of the granules.